Hayden Jananthan

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Research Interests

I am interested in the foundations of mathematics, particularly the ideas of computability, as well as in applications of traditionally 'pure' mathematics to applied contexts.

At Vanderbilt University, I study Muchnik degrees, algorithmic randomness (especially in the context of Muchnik degrees), hyperarithmetical theory.

At MIT, I study the application of associative arrays to scientific computing, machine learning, and database theory.

Education

Ph.D. Candidate, Russell G. Hamilton Scholar, Department of Mathematics, Vanderbilt University 2016 – current.

B.S. Mathematics, Massachusetts Institute of Technology, 2016.

> GPA: **5.0 / 5.0**

Research

Current Projects

PhD Candidate under Stephen Simpson at Vanderbilt University (2017 – current).

Intern in the Lincoln Laboratory Super Computing Center at MIT (2017 – current).

Past Projects

Research Assistant for Jeremy Kepner at MIT (2014 – 2016).

Publications

[12] J. Titensky, H. Jananthan, and J. Kepner. Uncertainty propogation in deep neural networks using extended kalman filtering. In *2018 IEEE MIT Undergraduate Research Technology Conference (URTC)*, Oct. 2018. Accepted, publication pending.

[11] K. Gravel, H. Jananthan, and J. Kepner. Visually representing the landscape of mathematical structures. In *Accepted to 2018 IEEE MIT Undergraduate Research Technology Conference (URTC), publication pending*, Oct. 2018. Accepted, publication pending.

[10] J. Kepner, R. Brightwell, A. Edelman, V. Gadepally, H. Jananthan, M. Jones, S. Madden, P. Michaleas, H. Okhravi, K. Pedretti, A. Reuther, T. Sterling, and M. Stonebraker. Tabularosa: Tabular operating system architecture for massively parallel heterogeneous compute engines. In *2018 IEEE High Performance extreme Computing Conference (HPEC)*, pages 1–8, Sep. 2018.

[9] J. Kepner, V. Gadepally, H. Jananthan, L. Milechin, and S. Samsi. Sparse deep neural network exact solutions. In *2018 IEEE High Performance extreme Computing Conference (HPEC)*, pages 1–8, Sep. 2018.

[8] J. Kepner and H. Jananthan. *Mathematics of Big Data: Spreadsheets, Databases, Matrices, and Graphs*. MIT Lincoln Laboratory Series. MIT Press, 2018. Forward by Charles E. Leiserson, XIII + 418 Pages.

[7] J. Kepner, S. Samsi, W. Arcand, D. Bestor, B. Bergeron, T. Davis, V. Gadepally, M. Houle, M. Hubbell, H. Jananthan, M. Jones, A. Klein, P. Michaleas, R. Pearce, L. Milechin, J. Mullen, A. Prout, A. Rosa, G. Sanders, C. Yee, and A. Reuther. Design, generation, and validation of extreme scale power-law graphs. In *2018 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*, pages 279–286, May 2018.

[6] H. Jananthan, Z. Zhou, V. Gadepally, D. Hutchison, S. Kim, and J. Kepner. Polystore mathematics of relational algebra. In *2017 IEEE International Conference on Big Data (Big Data)*, pages 3180–3189, Dec 2017.

[5] H. Jananthan, S. Kim, and J. Kepner. Linear systems over join-blank algebras. In *2017 IEEE MIT Undergraduate Research Technology Conference (URTC)*, pages 1–4, Nov 2017.

[4] H. Jananthan, K. Dibert, and J. Kepner. Constructing adjacency arrays from incidence arrays. In *2017 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*, pages 608–615, May 2017.

[3] J. Kepner, V. Gadepally, D. Hutchison, H. Jananthan, T. Mattson, S. Samsi, and A. Reuther. Associative array model of sql, nosql, and newsql databases. In *2016 IEEE High Performance Extreme Computing Conference (HPEC)*, pages 1–9, Sep. 2016.

[2] K. Dibert, H. Jansen, and J. Kepner. Algebraic conditions for generating accurate adjacency arrays. In *2015 IEEE MIT Undergraduate Research Technology Conference (URTC)*, pages 1–4, Nov 2015.

[1] J. Kepner, J. Chaidez, V. Gadepally, and H. Jansen. Associative arrays; unified mathematics for spreadsheets, databases, matrices, and graphs. In *2015 New England Database Summit*, Jan 2015. 4 pages.

Conference Talks

Posner-Robinson for Hyperjump of Turing Degrees, presented at the 20th annual Graduate Student Conference in Logic, Spring 2019, hosted at the University of Illinois, Chicago.

Constructing Adjacency Arrays from Incidence Arrays, presented at IEEE IPDPS 2017 Workshop on Graph Algorithm Building Blocks.

Other Talks

Posner-Robinson for Hyperjump of Turing Degrees, presented at the Vanderbilt Mathematics Department Universal Algebra and Logic Seminar, Spring 2019; the Summer School in Logic at the National University of Singapore, Summer 2019.

Teaching

Courses

Instructor of Single-Variable Calculus II (MATH 1201), Vanderbilt University, Spring 2019.

Teaching Assistant of Accelerated Single-Variable Calculus II (MATH 1301), Vanderbilt University, Fall 2018.

Teaching Assistant of Accelerated Single-Variable Calculus II (MATH 1301), Vanderbilt University, Spring 2018.

Teaching Assistant of Single-Variable Calculus I (MATH 1200), Vanderbilt University, Fall 2017.

Professional Development

Certificate in College Teaching - Seminar in College Teaching, Vanderbilt University, Fall 2018.

Teaching Assistant Orientation, Vanderbilt University, Fall 2017.

Scheller Teacher Education Program, Massachusetts Institute of Technology: Intro to Education I& II (MIT 11.124 & 11.125), Educational Theory and Practice I,II,& III (MIT 11.129, 11.130, & 11.131), Sheltered English Immersion (Wellesley EDUC 325), 2013 – 2016.

Mentoring

Katherine Gravel, MIT Math, MIT Undergraduate Research Opportunities Program, Summer 2018.

Marcus Jie, Vanderbilt Math, Vanderbilt Mathematics Club Directed Reading Program, Spring 2019.

Hana Kim, CalTech Math, MIT Undergraduate Research Opportunities Program, Summer 2017.

Jessica Titensky, MIT Math, MIT Lincoln Laboratory Summer Internship, Summer 2018.

Ziqi Zhou, MIT Math, MIT Undergraduate Research Opportunities Program, Summer 2017.

Training

TA Expert Panelist, Teaching Assistant Orientation, Vanderbilt University, Fall 2018 & Fall 2019.

Service

Committees

Mathematics Department Directed Reading Program Planning Committee, Spring 2019 – current.

Undergraduate Seminar in Mathematics Planning Committee, Fall 2016 – current.

Vanderbilt Math Club Graduate Student Advisor, Fall 2016 – Spring 2018.

Undergraduate Talks

Computability and the Church-Turing Thesis, presented at the Vanderbilt Undergraduate Seminar in Mathematics, Spring 2017.

Hilbert's Hotel and Cardinality, presented at the Vanderbilt Undergraduate Seminar in Mathematics, Fall 2017.

Weird Models, presented at the Pi Mu Epsilon Mathematics Honor Society Induction Ceremony, Fall 2017.

The Limitations of Ruler-and-Compass Constructions, presented at the Vanderbilt Undergraduate Seminar in Mathematics, Spring 2018.

This Title is False, presented at the Vanderbilt Undergraduate Seminar in Mathematics, Fall 2018.

What's Yellow and Equivalent to the Axiom of Choice?, presented at the Vanderbilt Undergraduate Seminar in Mathematics, Spring 2019.

The Axiom of Choice, presented at MIT Educational Studies Program's Splash!, Fall 2015.

Understanding Infinity: Ordinals and Cardinals, presented at MIT Educational Studies Program's Splash!, Fall 2015.

Elementary Introduction to Set Theory, presented at MIT Educational Studies Program's Sprinkler!, Spring 2013.

Arithmetic on Clocks: When $2 + 2 = 1$, presented at MIT Educational Studies Program's Sprinkler!, Spring 2013.

Topological Oddities: Mobius Strips, Klein Bottles, and more, presented at MIT Educational Studies Program's Sprinkler!, Spring 2013.

The Size of the Natural Numbers and Other Infinities, presented at MIT Educational Studies Program's Sprinkler!, Spring 2013.

Quarks, Electrons, and More, presented at MIT Educational Studies Program's Sprinkler!, Spring 2013.

Intro to Set Theory, presented at MIT Educational Studies Program's Splash!, Fall 2012.

Technical Skills

Programming

Python, LaTeX, Julia, MATLAB, SQL, D4M

Qualifications

MA Initial License for Mathematics Grades 08-12, Scheller Teacher Education Program, Massachusetts Institute of Technology, 2016.

Awards

University Graduate Fellowship, Vanderbilt University, 2016 - current.

Last updated: August 15, 2019